

Nicholas C. Metropolis Center for Modeling and Simulation



The Metropolis Center is a three-story, 303,000-square-foot structure built to house “Q” one of the world’s largest and most capable computers (initially 30 teraOps, or 30 trillion floating point operations per second). The Center is an integrated part of the National Nuclear Security Administration’s tri-lab (Los Alamos, Lawrence Livermore and Sandia) mission to maintain, monitor and assure the performance of the nation’s nuclear weapons through the Advanced Simulation and Computing program. All three laboratories will share the Q computer resource, through extremely fast distance networks.

Los Alamos and Hensel-Phelps Construction Co. of Greeley, Colo., completed the project \$13 million under budget and more than three months ahead of schedule. This successful partnership represented the first time Los Alamos used the integrated design/build concept on a major project.

More than 1,000 workers took part in the construction project, completing 600,000 labor hours with only one lost work day, due to an infection. The Center features a specially designed 43,500-square-foot computer room — nearly the size of a football field — supported by electrical and mechanical rooms in excess of 60,000 square feet.

Supporting Research

About 300 nuclear weapons designers, computer scientists, engineers and other researchers are moving into the facility, where they will extend the cutting edge of simulation and modeling development in support of nuclear weapons stockpile stewardship. They work in 306 furnished work spaces, several conference rooms, visualization theaters, classrooms, break areas and collaboration laboratories. All aspects of the design were specifically aimed at providing the Laboratory with the latest in support of high-performance computing.

Seeing the Data

The enormous calculations that researchers run on the Q machine require new methods of understanding and seeing the data generated. The Metropolis Center’s visualization environment consists of two immersive visualization theaters that represent the best available capability for data viewing and analysis, along with a 200-seat auditorium. A secure power-wall theater provides high-resolution interleaved displays that fill a wall with the latest projection technology, together with conference capability, multiple display monitors, and electronic white-boards to

promote effective teaming and collaborative discussions.

Five “collaboratories” supply a third simulation environment to promote collaborations among weapons code development teams who integrate experiments, materials science, physics and computer science. The collaboratories provides users, code developers and managers with an informal, information- and technology-rich environment with systems for simulation development, collaboration, discussion, media development, presentation and problem analysis.

Power and Room to Grow

The facility infrastructure is designed to be scalable, with mechanical and electrical equipment installed to support up to 30 teraOPS. As requirements go beyond the 30-teraOPS capability, mechanical and electrical equipment — including chiller, cooling towers, air-conditioning units, substations, power conditioners and transformers — can be added in increments without expanding the building. Scalability provides a cost-effective option of waiting to install additional support equipment until it is needed and the ability to capitalize on technological advances in computing technology, as well as in the support equipment.

The facility is fed by two different 13.2 kV underground power sources and is



The Nicholas C. Metropolis Center for Modeling and Simulation, the most capable simulation facility in the world.

configured with double-ended switch gear and unit substations to allow switching for maintenance and fault isolation. Power conditioners, transformers and distribution equipment are rated for the high harmonics generated by the computer.

A grounding ring surrounds the building in addition to a signal reference grid in the computer room to reduce electrical noise. A lightning-protection system is incorporated into the facility. A fire-detection system monitors the entire building, along with a highly sensitive smoke-detection system under the raised-computer floor. Communication lines service the facility through an underground duct-bank system utilizing fiber optic cable for both secure and open systems. Copper lines are used for the voice-communication system.

Mechanical systems also are designed for maximum flexibility. The computer-room cooling system can be adapted for air-cooled computers, water-cooled computers or a combination. The simulation laboratory spaces are heated, cooled and ventilated with modular, variable-volume air handling units, with separate air-handling systems for classified and unclassified areas.

Cooling-tower heat exchangers meet cooling requirements without running chillers during winter and cooler months, providing energy conservation.

Metropolis Center Fast Facts

Cost and Schedule

- Baseline budget: \$106 million
- Actual cost: \$93 million
- FY98 and FY99: planning and design/build procurement
- FY00 and FY01: design and construction
- FY02: Project close out
- Significant milestone: computer floor scheduled completion Jan. 2, 2002; actual completion Sept. 17, 2001

Dimensions

- 303,000 square feet (over six football fields)
- Unobstructed 43,500-square-foot computer room
- Approximately 500 feet long by 300 feet wide
- 306 offices designed to support state-of-the-art computing

Structure

- 12,000 cubic yards of concrete (football field seven feet deep in concrete)
- 1,400 tons of structural steel (500 pickup trucks)
- 650 tons of concrete reinforcing (200 miles of rebar)
- 8,000 gallons of paint

Electrical/Fiber

- 10,000 receptacles (plug-ins)
- 7.1 megawatts of power, expandable to 30 MW
- 200-plus miles of wire
- 1,350-plus miles of individual fibers
- 20,000 fiber terminations

Mechanical

- Pipes hold 130,000 gallons of water
- 3,600 tons of cooling capacity (enough to cool 500 homes)
- 2,300 fire sprinkler heads
- 8,500 feet of tubing for high-sensitivity smoke-detection system

Safety

- More than 1,000 workers
- 600,000-plus labor hours
- One lost work day injury (infection)
- Two recordable injuries (both back strains)

Awards to Metropolis Center Project and Personnel

Department of Energy

- Department of Energy Award of Achievement
- Program and Project Management Award from Defense Programs
- Performance Excellence Award 2000 from the Albuquerque Operations Office
- Knowledge Sharing Award from the National Nuclear Security Administration
- Performance Excellence Award 2001 from the Albuquerque Operations Office

Other awards:

- Distinguished Performance Award from Los Alamos National Laboratory
- Engineering Excellence Award from American Consulting Engineers Council of New Mexico
- Finalist, National Engineering Excellence Awards from the American Consulting Engineers Council
- Mechanical Project of Year from Southwest Contractor Magazine
- Associated General Contractors' 2002 Build America Award Design-Build Category
- Los Alamos Awards Program from Los Alamos National Laboratory



Los Alamos National Laboratory is operated by the University of California for the U.S. Department of Energy's National Nuclear Security Administration